

First CNMS  
User Meeting  
May 23–25, 2005  
Oak Ridge, TN

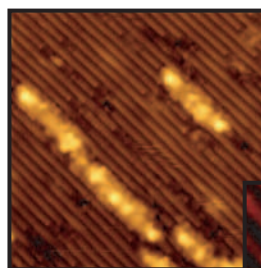
## Center for Nanophase Materials Sciences

The Center for Nanophase Materials Sciences (CNMS) at Oak Ridge National Laboratory (ORNL) will integrate nanoscale science with neutron science; synthesis science; and theory, modeling, and simulation. Operating as a national user facility, the CNMS will create unique opportunities to understand nanoscale materials and phenomena in a highly collaborative and multidisciplinary environment. It will provide a broad community of scientists, engineers, and students from throughout the nation, but particularly the southeastern United States, with readily accessible resources for research focusing on the controlled synthesis and directed assembly of functional nanomaterials and on the integration of soft (polymeric, biological) and hard materials.

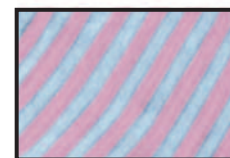
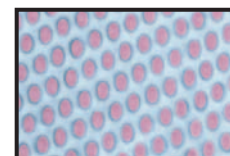
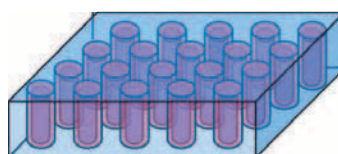
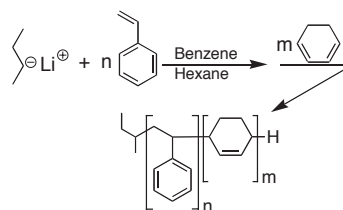
### Scientific Themes

Research will be organized under seven related scientific thrusts, selected to address grand challenges to scientific understanding and nanotechnology needs.

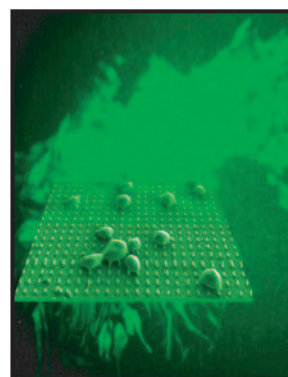
- Macromolecular Complex Systems:**  
Organic, hybrid, and interfacial nanophases, including polymers, biologically derived systems, and nanoconfined fluids.
- Functional Nanomaterials:** Carbon nanotubes and related structures, structural nanocomposites, nanoscale mechanics, and nanointerface science.
- Nanoscale Magnetism and Transport:**  
Nanoscale magnetism, manipulation of collective behavior, effects of reduced dimensionality, and quantum transport.
- Catalysis and Nano Building Blocks:**  
Nanostructured catalysts and synthesis of functional nano building blocks (organic and inorganic).
- Nanofabrication:** Facilities and techniques for controlled synthesis and directed assembly, to link nanoscale phenomena to the macroscale and to functionally integrate soft and hard materials, including nanostructures for sensing and electronics.
- Theory, Modeling, and Simulation:**  
Computational nanoscience (multiscale modeling, nanomaterials design, and virtual synthesis) using terascale computing capabilities, developed through the Nanomaterials Theory Institute.
- Nanoscale Imaging and Characterization:**  
New methods to manipulate nanostructures for properties measurements using neutron scattering, or methods combining electron microscopy with scanning probe and environmental techniques.



*Oxygen adsorption and 1D defect on TiO<sub>2</sub> (110) surface, from scanning probe studies of nanostructured catalysts*



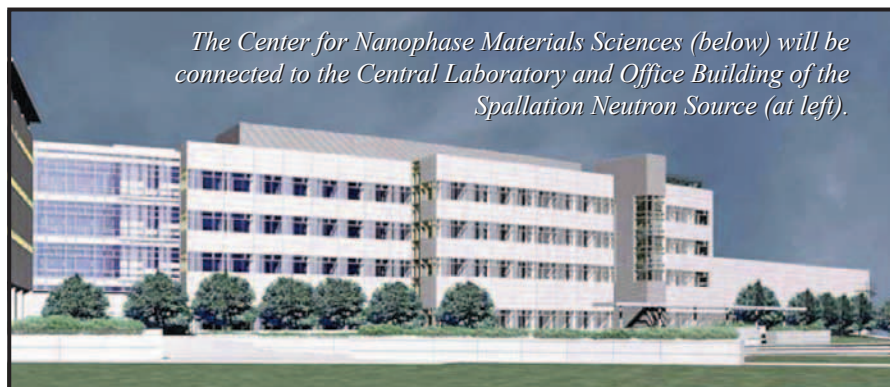
*Core-shell cylinder morphology in poly(styrene-*b*-1,3-cyclohexadiene) diblock copolymers*



*Genetic manipulation of viable Chinese hamster ovary (CHO) cells using deterministically grown carbon nanofiber arrays*

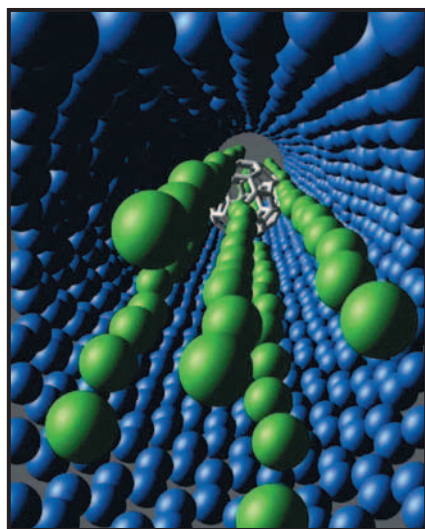
## Facilities and Capabilities

The CNMS will be housed in a new 80,000-ft<sup>2</sup> building on Chestnut Ridge, near the Spallation Neutron Source (SNS). Construction of the CNMS facility began in summer 2003. The four-level main building comprises wet and dry laboratories, office space, and common areas to promote interaction among staff, long-term research guests, and users. It will be equipped with a wide range of specialized tools for synthesis, characterization, and integration of hard and soft materials. The 10,000-ft<sup>2</sup> Nanofabrication Research Laboratory, housed in a one-level wing of the building, includes clean rooms and an area designed to meet the requirements of electron-beam imaging and writing instruments (low electromagnetic field, low vibration, low acoustic noise). The Nanomaterials Theory Institute will provide collaborative workspaces, visualization equipment, and high-speed connections to the terascale computing facilities of ORNL's Center for Computational Sciences.

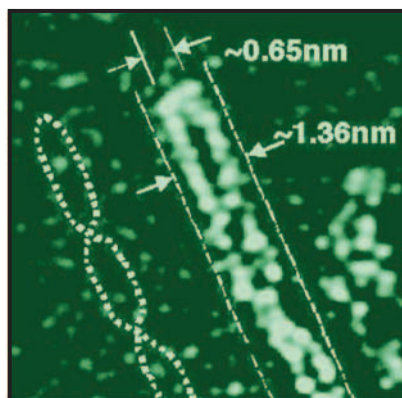


*The Center for Nanophase Materials Sciences (below) will be connected to the Central Laboratory and Office Building of the Spallation Neutron Source (at left).*

The intense neutron beams from the SNS (which is scheduled to begin operation in 2006) and from the recently upgraded High Flux Isotope Reactor afford unique opportunities for fundamental studies of the structure and dynamics of nanomaterials. The CNMS will provide a gateway to these and other ORNL user facilities, including electron microscopy in the Shared Research Equipment and High Temperature Materials Laboratory user programs, for users whose research can benefit from access to multiple facilities.



*Computer simulation of a fullerene molecule (white) moving a helium-atom fluid (green) through a carbon nanotube (blue).*



*Electron microscopy reveals a double helix chain of iodine atoms inside a carbon nanotube.*

## User Program

The CNMS user program will provide access to equipment for nanoscale research that defines the state of the art. Users will join a vibrant research community that brings together ORNL research staff, technical support staff, students, postdoctoral scholars, and collaborating guest scientists. The program will accommodate both short-term and long-term collaborative research partners. Access will be through brief peer-reviewed proposals. In July 2003, ORNL opened its first call for proposals in a user-initiated nanoscience research program that draws on existing nanoscience capabilities and staff.

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